

CLAIMS

I Claim;

1.) A method for controlling the molecular weight of a polymer by permeating the polymer with a permeant while the polymer is in the solid state and has a degree of disentanglement of essentially zero, and subjecting the polymer plus permeant blend to a melt processing operation.

2.) The method of claim 1 in which the polymer is selected from the group consisting of ethylene propylene copolymer, high-density polyethylene, high-impact polystyrene, low-density polyethylene, polyamide, polyacrylic acid, polyamide-imide, polyacrylonitrile, polyarylsulfone, polybutylene, polybutadiene acrylonitrile, polybutadiene styrene, polybutadiene terephthalate, polycarbonate, polycaprolactone, polyethylene, polyethyl acrylate, polyetheredierketone, polyethylene sulfone, polyethylene terephthalate, polyethylene terephthalate glycol, polyimide, polyisobutylene, polymethyl acrylate, polymethyl ethyl acrylate, polymethyl methacrylate, polyoxymethylene (polyacetal), polyphenylene ether, polyphenylene oxide, polyphenylene sulfide, polypropylene terephthalate, polystyrene, polytetrafluoroethylene, polyurethane, polyvinyl alcohol, polyvinyl acetate, polyvinyl chloride, polyvinylidene chloride, polyvinylidene fluoride, polyvinyl methyl ether, polyvinyl methyl ketone, styrene butadiene, styrene butadiene rubber, cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, cellulose nitrate, chlorinated polyethylene, chlorotrifluoroethylene, ethylene acrylic acid, ethylene butyl acrylate, ethyl cellulose, and polymers and copolymers of acrylonitrile butadiene acrylate, acrylonitrile butadiene styrene, acrylonitrile, chlorinated PE and styrene, acrylonitrile methyl methacrylate, acrylonitrile, acrylonitrile styrene, acrylonitrile, butadiene acrylonitrile, ethylene propylene diene monomer, and blends or copolymers of the preceding.

3.) The method of claim 1 in which the permeant is selected from the group consisting of; carbon dioxide, nitrogen, oxygen, hydrogen, helium, argon, neon,

nitrous oxide, nitric oxide, water, dicumyl peroxide, butyl cumyl peroxide, di-t-butyl peroxide, dimethyl di-t-butyl-peroxyhexane, bis(t-butylperoxy)-di-isopropylbenzene, ethylene glycol dimethacrylate, butylene glycol dimethacrylate, diallyl terephthalate, triallyl isocyanurate, trimethylol propane trimethacrylate, m-phenylene-dimaleimide, pentane, maleic anhydride, silyl peroxide, aluminum trichloride, p-Xylene, trichlorobenzene, toluene, and blends or combinations of the above.

4.) The method of claim 1 in which the permeant is selected from a group that is a member of the group consisting of; silanes, siloxanes, polyesters, halogenated monomers, titanates, acid anhydrides, Lewis acid inorganic, aliphatic monocarboxylic acid esters, aromatic monocarboxylic acids, aliphatic dicarboxylic acid esters, phosphates, polyester or polymeric plasticizers, phenols and amines, phosphates, sulfur containing stabilizers, hindered amine light stabilizers, hydroxyphenylpropionates, hydroxybenzyl compounds, alkylidene bisphenols, secondary aromatic amines, thiobisphenols, aminophenols, thioethers, phosphates and phosphonites, metal deactivators, amides of aliphatic and aromatic mono and dicarboxylic acids and their N-monosubstituted derivatives, cyclic amides, hydrazones, bishydrazones of aliphatic and aromatic aldehydes, bis acylated hydrazine derivatives, benzotriazoles, 8-oxyquinoline, hydrazones, acylated derivatives of hydrazinotriazines, aminotriazoles and acylated derivatives thereof, polyhydrazides, nickel salts of benzyl phosphonic acids, alone, or in combination with other antioxidants or metal deactivators, pyridenethiol tin compounds, phosphorous acid esters of a thiobisphenol and blends or combinations of the above.

5.) The method of claim 1 in which the permeant is a solvent for the polymer.

6.) The method of claim 1 in which the permeant is selected from a group consisting of an alkane, an alkene, an alcohol, an ether, a chlorofluorocarbon, and any blends or combinations of any of the preceding.

7.) The method of claim 1 in which the permeant is cyclic butylene terephthalate and the polymer is polycarbonate or a polyester.

8.) A method for controlling the molecular weight of a polymer in which a polymer of a desired molecular weight and viscosity is obtained, the method comprising the following steps;

- i. providing a solid polymer that has a degree of disentanglement of essentially zero,
- ii. providing a permeant,
- iii. drying the polymer to an effective level of moisture,
- iv. permeating the polymer by contacting the dried polymer with the permeant for a controlled time and at a controlled temperature and pressure,
- v. subjecting the polymer plus permeant to a melt processing operation during which the polymer is melted and the melted polymer is subjected to shear,

in which method the combination of melt processing temperature, melt processing shear rate, duration of melt processing, level of drying and time of exposure to drying, time, temperature and pressure of exposure to permeant and the nature of the polymer and permeant are such that the desired combination of molecular weight and viscosity are obtained.

9.) The method of claim 8 in which the polymer is selected from the group consisting of ethylene propylene copolymer, high-density polyethylene, high-impact polystyrene, low-density polyethylene, polyamide, polyacrylic acid, polyamide-imide, polyacrylonitrile, polyarylsulfone, polybutylene, polybutadiene acrylonitrile, polybutadiene styrene, polybutadiene terephthalate, polycarbonate, polycaprolactone, polyethylene, polyethyl acrylate, polyetheredierketone, polyethylene sulfone, polyethylene terephthalate, polyethylene terephthalate glycol, polyimide, polyisobutylene, polymethyl acrylate, polymethyl ethyl acrylate,

polymethyl methacrylate, polyoxymethylene (polyacetal), polyphenylene ether, polyphenylene oxide, polyphenylene sulfide, polypropylene terephthalate, polystyrene, polytetrafluoroethylene, polyurethane, polyvinyl alcohol, polyvinyl acetate, polyvinyl chloride, polyvinylidene chloride, polyvinylidene fluoride, polyvinyl methyl ether, polyvinyl methyl ketone, styrene butadiene, styrene butadiene rubber, cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, cellulose nitrate, chlorinated polyethylene, chlorotrifluoroethylene, ethylene acrylic acid, ethylene butyl acrylate, ethyl cellulose, and polymers and copolymers of acrylonitrile butadiene acrylate, acrylonitrile butadiene styrene, acrylonitrile, chlorinated PE and styrene, acrylonitrile methyl methacrylate, acrylonitrile, acrylonitrile styrene, acrylonitrile, butadiene acrylonitrile, ethylene propylene diene monomer, and blends or copolymers of the preceding.

10.) The method of claim 8 in which the permeant is selected from the group consisting of; carbon dioxide, nitrogen, oxygen, hydrogen, helium, argon, neon, nitrous oxide, nitric oxide, water, dicumyl peroxide, butyl cumyl peroxide, di-t-butyl peroxide, dimethyl di-t-butyl-peroxyhexane, bis(t-butylperoxy)-di-isopropylbenzene, ethylene glycol dimethacrylate, butylene glycol dimethacrylate, diallyl terephthalate, triallyl isocyanurate, trimethylol propane trimethacrylate, m-phenylene-dimaleimide, pentane, maleic anhydride, silyl peroxide, aluminum trichloride, p-Xylene, trichlorobenzene, toluene, and blends or combinations of the above.

11.) The method of claim 8 in which the permeant is selected from a group that is a member of the group consisting of; silanes, siloxanes, polyesters, halogenated monomers, titanates, acid anhydrides, Lewis acid inorganic, aliphatic monocarboxylic acid esters, aromatic monocarboxylic acids, aliphatic dicarboxylic acid esters, phosphates, polyester or polymeric plasticizers, phenols and amines, phosphates, sulfur containing stabilizers, hindered amine light stabilizers, hydroxyphenylpropionates, hydroxybenzyl compounds, alkylidene bisphenols, secondary aromatic amines, thiobisphenols, aminophenols, thioethers,

phosphates and phosphonites, metal deactivators, amides of aliphatic and aromatic mono and dicarboxylic acids and their N-monosubstituted derivatives, cyclic amides, hydrazones, bishydrazones of aliphatic and aromatic aldehydes, bis acylated hydrazine derivatives, benzotriazoles, 8-oxyquinoline, hydrazones, acylated derivatives of hydrazinotriazines, aminotriazoles and acylated derivatives thereof, polyhydrazides, nickel salts of benzyl phosphonic acids, alone, or in combination with other antioxidants or metal deactivators, pyridenethiol tin compounds, phosphorous acid esters of a thiobisphenol and blends or combinations of the above.

12.) The method of claim 8 in which the permeant is a solvent for the polymer.

13.) The method of claim 8 in which the permeant is selected from a group consisting of an alkane, an alkene, an alcohol, an ether, a chlorofluorocarbon, and any blends or combinations of any of the preceding.

14.) The method of claim 8 in which the permeant is cyclic butylene terephthalate and the polymer is polycarbonate or a polyester.

15.) The method of claim 8 in which the controlled temperature is obtained by subjecting the polymer to microwave radiation or radio frequency radiation.

16.) The method of claim 8 in which the polymer is in the form of pellets, and during the steps of being subjected to a vacuum, or contact with the permeant, the pellets are either subjected to a means for agitation by a rotating blade, or is subjected to vibratory motion.

17.) The method of claim 8 in which the steps of drying and permeation are carried out on a rotating carousel, said carousel comprising two or more containers that are rotated in order to carry out the operations of the method in sequence.

18.) The method of claim 8 in which the steps of drying the polymer and contacting the dried polymer with a permeant are carried out in the same extruder barrel as is the melt processing operation.

19.) A product made by the process of controlling the molecular weight of a polymer by permeating the polymer with a substance while the polymer is in the solid state and has a degree of disentanglement of zero, and subjecting the polymer plus permeant blend to a melt processing operation.

20.) A product made by the process of obtaining a polymer of a desired molecular weight and viscosity, comprising the following steps;

- i. providing a solid polymer which has a degree of disentanglement of essentially zero,
- ii. providing a permeant,
- iii. drying the polymer to an effective level of moisture,
- iv. contacting the dried polymer with the permeant for a controlled time and at a controlled temperature and pressure,
- v. subjecting the polymer plus permeant to a melt processing operation during which the polymer is melted and the melted polymer is subjected to shear,

in which method the combination of melt processing temperature, melt processing shear rate, duration of melt processing, level of drying and time, pressure and temperature of exposure to permeant and the nature of the polymer and permeant are such that the desired combination of molecular weight and viscosity are obtained.